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THE USE OF THE NITRITE TEST IN DETERMINING THE SOURCE OF POLLUTION OF A WATER SUPPLY

By William Miller Booth

Serious objection has recently been raised to the reliability and usefulness of the standard sanitary chemical tests for water. The object of this communication is to show how the nitrite test was applied to good advantage, in tracing a source of pollution.

The reservoir shown in the cut (fig. 1) consists of two excavations, walled at the sides, and fed by springs in the bottom. The land about slopes toward the reservoirs from the south, west and north, the natural outlet for the basin being toward the north-east. A small stream (*T*) overflows from the lower reservoir and joins a creek which is usually dry by the middle of summer, shown at *M*.

The water is pumped to a standpipe on the hill, shown at the right. This elevation is of shale and separates the watershed in which the reservoirs are located from the city at the other side. A highway passes at the base of the hill. A natural depression follows from a small wood at the south, northward, to the left of the highway.

When the writer was first acquainted with the locality it was timbered between stream and highway to the upper or first reservoir. This section was often used as a picnic ground. His first sanitary analysis of the water led to the suggestion that the reservoirs be cleaned. As several years had elapsed since this had been done, men were at once employed to do this. Although not shown in the tables, the ammonias soon lowered to the limit of an excellent potable water.

The writer next suggested that the woods property be purchased. This was cut over and the land was bought by the water company—an area of perhaps 20 acres.

In April, 1903, the writer made a second analysis, shown in table under No. 2. This easily places the water in the first class from a sanitary and bacteriological standpoint.

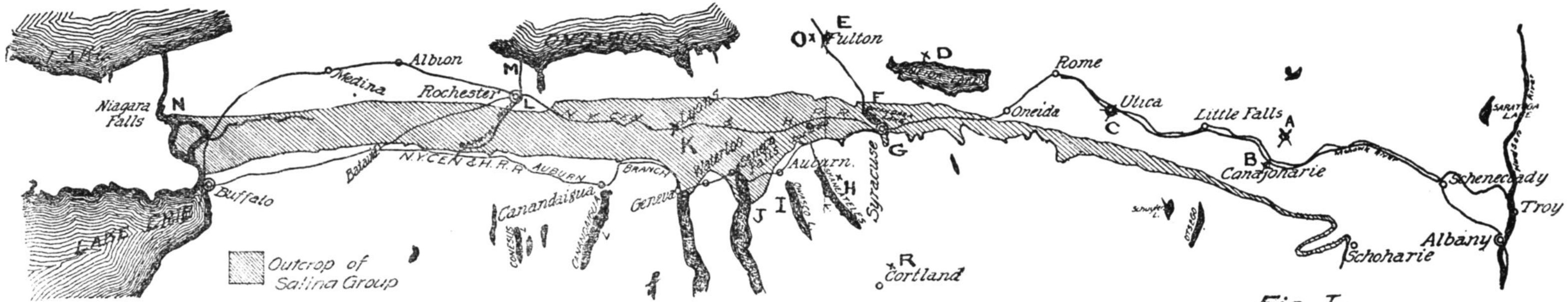LAKE ONTARIO
Niagara Falls
N
Medina
Albion
M
Rochester
L
Batavia
N.Y.CEN & H.R.R. AUBURN BRANCH
Canandaigua
CANANDAIGUA L
CONESUS
Geneva
Lyons
K
Waterloo
Seneca Falls
Auburn.
OWASCO L
SKANEATELES L.
J
I
H
Syracuse
G
F
E
O
Fulton
D
R
Cortland
Oneida
Rome
Utica
C
Little Falls
A
B
Canajoharie
Mohawk River
OTSEGO
Schuyler L.
Schoharie
Schenectady
Albany
Troy
SARATOGA LAKE
Hudson River
LAKE ERIE
Buffalo
Outcrop of Salina Group

Fig. I.

In May, 1906, a third analysis was called for to serve as a part of the record kept by the company. This showed the presence of nitrites and that the number of colonies on gelatine was unusually high for this water; the ammonias had also increased. The president of the company immediately called for a second analysis, which is shown in the table as No. 4. To the writer the conditions seemed alarming and he suggested immediate action in what seemed to be a case of serious pollution. The day but one following, a number of sample bottles and cases and the materials for the nitrite test as prescribed by Doctor Mason were taken into the field, freshly prepared solutions being used.

Two men were provided with a 10-foot length of inch iron pipe, with a perforated and pointed tip. This was driven at station I until about 8 feet had entered the ground. A pump was screwed in place and water elevated and allowed to waste for ten minutes. Sufficient was then bottled for further examination.

This operation was repeated at wells 2, 3, 4, 5, 6, 7 and 8. In the meantime the nitrite test was applied at A, 1, 2 and 3, with the results shown.

Crossing the stream the creek water from a pond through a meadow was tested. This developed a slight pink in five minutes. A small spring just across the stream at *X* showed a strong nitrite test at once. The writer looked just back of this and discovered two piles of swine in a partially decomposed state. There were eighty of these weighing perhaps 150 pounds each.

The problem of pollution was now pretty well solved but did not account for an abnormal nitrate test in the hollow between the road and the ridge south of the reservoir. Examination showed this to be the burial place for horses and cows that had died in the neighborhood. Further examination showed that the territory where the swine were found was the city garbage piggery and dog pound. Many of the latter had been chloroformed and buried in the vicinity.

To add to the unpleasant features of the situation, a partly decomposed Newfoundland dog was found near the reservoir from which sample No. 4 was taken. Please understand that the water from the reservoir supplied a town of 10,000 people.

The water company spared no expense to place the property in a sanitary condition. The analyses made from time to time show how the water gradually righted itself and how serious results to the people were averted by a solid bank of sand between the piggery and the reservoirs.

In this and subsequent cases the writer has used the nitrite test to determine animal pollution with excellent results.

The owner of the pigsty was the chairman of the local board of health and himself a physician.

LOCATION	NO.	TOTALSOLIDS	CHLORINE	FREE AMMONIA	ALB. AMMONIA	NITRATES IN NITROGEN	NITRITES IN NITROGEN	OXYGEN CONDENSED	CALORIES PER CC.	B. COLI	DATE	REMARKS
Syracuse	1	54	0.00	0.06	0.094	0.00	0.000				Feb. 1910	Rain water
Syracuse	2	24	trace	0.02	0.025	0.005	0.006				Nov. 1910	Snow water
Otselic	3		8.8	0.002	0.002	0.00	0.0016				Mar. 1903	Ice from pond
Cazenovia	4		1.1	0.019	0.000	0.000			16	Absent		Ice on lake
Syracuse	5	130	2.2	0.30	0.15	0.04	0.060				June 1909	Cistern water
Syracuse	6	14	0.0	0.002	0.002	0.00	0.0005				Aug. 1912	Distilled city water
Syracuse	7	120	1.0	0.005	0.045	0.40	0.000				Aug. 1912	Raw water for No. 6
Syracuse	8	724	117.5	0.012	0.07	0.12	0.004				Aug. 1910	Onondaga Creek
Syracuse	9	770	118	3.50	0.90	0.00	0.000	23.37			Aug. 1910	Onondaga Creek into lake
Syracuse	10	844	241	0.013	0.16	0.18	0.020	5.00			Aug. 1910	Onondaga Lake
Syracuse	11	2674	1043	0.004	0.254	0.00	0.080	5.00			Aug. 1910	Onondaga Lake
Syracuse	12	2744	1056	0.005	0.43	0.00	0.080	7.60			Aug. 1910	Onondaga Lake
Syracuse	13	2584	1031	0.005	0.37	0.00	0.080	5.50			Aug. 1910	Onondaga Lake
Syracuse	14	2600	1037	0.006	0.43	0.02	0.080	5.50			Aug. 1910	Onondaga Lake
Syracuse	15	2454	1047	0.005	0.22	0.03	0.080	5.37			Aug. 1910	Onondaga Lake
Syracuse	16	2848	1050	0.004	0.31	0.03	0.080	5.37			Aug. 1910	Onondaga Lake
Syracuse	17	2720	1040	0.002	0.17	0.03	0.080	4.87			Aug. 1910	Onondaga Lake
Syracuse	18	2720	1072	0.002	0.23	0.03	0.080	4.75			Aug. 1910	
Syracuse	19	2606	1063	0.004	0.22	0.05	0.080	5.12			Aug. 1910	
Syracuse	20	1126	50		2.84							Seneca River Junction
Syracuse	21	21456	9170	3.18	0.52	0.00	0.160	27.12				Sewer outlet from city
Skaneateles	22	132	2.0	0.03	0.06	0.48	0.000	1.11			Oct. 1906	Lake supplying Syracuse (south end)
Skaneateles	23	122	2.0	0.015	0.055	0.45	0.000	1.01			Oct. 1906	40 ft. below surface; intake (north end)
Syracuse	24	127	1.94	0.000	0.062	0.36	0.000	0.87	28	Negative		Intake; reservoir
Syracuse	25	124	1.94	0.000	0.075	0.35	0.000	1.12				Outlet; reservoir
Syracuse	26	120	1.5	0.006	0.035	0.29	0.000	0.87			Nov. 22, 1905	Down town office
Skaneateles	27	260	5.0	0.070	0.165	0.52	0.012	2.12			Feb. 1909	Creek below lake outlet
Skaneateles	28	196	5.0	0.110	0.140	0.74	0.012	2.50			Feb. 1909	Creek below lake outlet
Skaneateles	29	310	8.0	0.050	0.270	0.80	0.012	6.00			Feb. 1909	Creek below lake outlet
Skaneateles	30	182	5.5	0.035	0.090	0.77	0.012	2.62			Feb. 1909	Creek below lake outlet
Fulton	31	136	14.0	0.102	0.52	0.02	0.000	8.17			June 1911	Lake outlet
Fulton	32	146	19.0	0.26	0.62	0.02	0.0005	10.9				Polluted; above
Fulton	33	220	10.0	0.26	0.66	0.26	0.2000	11.0				Polluted; above
Fulton	34	150	25.0	0.90	1.18	0.000	0.000	21.2				Polluted; above

Fulton...............	35	520	57.5	10.80	2.06	0.000	0.000	20.42	....	....	....	Polluted; above
Fulton...............	36	414	41.5	21.5	5.50	0.000	0.000	40.40	....	....	....	Polluted; above
Fulton...............	37	1756	650	0.00	68.60	0.000	0.000	260.0	....	....	....	Polluted; above
Charlotte............	38	154	9.8	0.16	0.06	0.08	0.0003	0.40	30	Positive	Nov. 1912	Lake Ontario. Raw
Charlotte............	39	152	11.6	0.10	0.04	0.10	0.000	0.42	22	Negative	Nov. 1912	Filtered
Fairport.............	40	154	9.8	0.08	0.07	0.08	0.000	0.55	130	Negative	Nov. 1912	Same at Fairport
Lockport.............	41	200	10.8	0.06	0.252	0.08	0.000	0.75	30	Positive	Nov. 1912	Niagara River water
Rochester............	42	90	5.8	0.000	0.08	0.18	0.000	....	20	Negative	Nov. 1912	Hemlock Lake supply
Seneca Falls.........	43	200	30.0	0.06	0.154	0.20	0.003	0.48	50	Negative	Nov. 1906	Intake—North end—Cayuga Lake (Booth)
Seneca Falls.........	44	170	31.0	0.03	0.08	0.40	0.005	1.50	....	Negative	July 1907	Same Lederle Laboratories
Seneca Falls.........	45	180	30.0	0.00	0.09	0.23	0.002	0.48	40	Negative	Nov. 1906	House in city (Booth)
Seneca Falls.........	46	214	32.5	0.01	0.13	0.20	0.000	....	....	Negative	July 1907	Same Lederle Laboratories
Bridgeport...........	47	196	30.0	0.053	0.10	0.20	0.003	0.48	65	Negative	Nov. 1906	South of intake 12 ft. under
Lewis Pt.............	48	200	30.0	0.005	0.10	0.28	0.010	0.48	140	Positive	Nov. 1906	Further south 12 ft. under
Canoga Landing......	49	180	30.0	0.000	0.092	0.25	0.002	0.36	34	Negative	Nov. 1906	Five miles south of intake
Cayuga Lake.........	50	268	51.0	0.000	0.08	0.20	0.000	1.30	20	Negative	Spring 1911	Two miles from intake, twelve feet under surface
Seneca Falls.........	51	270	51.0	0.07	0.18	0.22	0.0005	1.75	50	Negative	Spring 1911	House in city
Central New York...	52	......	8.0	0.013	0.110	....	0.005	....	....	....	Sept. 1902	Private water works (house faucet)
Central New York...	53	116	4.0	0.000	0.040	1.00	0.000	....	2	....	Apr. 1903	Reservoir
Central New York...	54	116	4.0	0.066	0.070	1.07	0.0065	....	98	....	May 17, 1906	Reservoir
Central New York...	55	......	4.0	0.047	0.041	0.75	0.0062	....	1000	....	May 28, 1906	Reservoir
Central New York...	56	......	4.0	0.015	0.071	0.66	0.0062	....	....	....	May 30, 1906	Well No. 1
Central New York...	57	......	4.5	0.026	0.076	0.50	0.003	....	....	....	May 30, 1906	Well No. 2
Central New York...	58	......	2.5	0.046	0.13	0.80	0.002	....	....	....	May 30, 1906	Well No. 3
Central New York...	59	......	....	....	....	....	0.000	....	....	....	May 30, 1906	Spring A
Central New York...	60	......	....	....	....	2.00	....	....	....	....	May 30, 1906	Depression "C"
Central New York...	61	......	....	0.000	0.105	0.84	0.046	....	....	....	June 1, 1906	Well No. 4
Central New York...	62	......	....	0.000	0.134	1.00	0.044	....	....	....	June 1, 1906	Well No. 5
Central New York...	63	......	....	0.002	0.135	0.74	0.044	....	....	....	June 1, 1906	Well No. 6
Central New York...	64	......	....	0.002	0.134	1.04	0.036	....	....	....	June 1, 1906	Well No. 7
Central New York...	65	......	....	0.002	0.090	1.04	0.036	....	....	....	June 1, 1906	Well No. 8
Central New York...	66	......	....	0.0015	0.003	1.08	0.006	....	....	....	June 1, 1906	Reservoir
Central New York...	67	......	3.6	0.061	0.140	1.12	0.003	....	....	....	June 5, 1906	Well at "C"
Central New York...	68	......	5.6	0.018	0.052	0.93	0.0065	....	....	....	June 5, 1906	Reservoir
Central New York...	69	......	4.7	0.053	0.080	1.03	0.0065	....	....	....	June 7, 1906	Reservoir

LOCATION	NO.	TOTAL SOLIDS	CHLORINE	FREE AMMONIA	ALB. AMMONIA	NITRATES IN NITROGEN	NITRITES IN NITROGEN	OXYGEN CONDENSED	CALORIES PER CC.	B. COLI	DATE	REMARKS
Central New York	70		5.0	0.052	0.120	0.50	0.008				June 9, 1906	Reservoir after storm
Central New York	71		5.0	0.013	0.025	1.35	0.016				June 13, 1906	Reservoir
Central New York	72		5.0	0.005	0.020	1.19	0.005				June 14, 1906	Reservoir
Central New York	73		5.0	0.034	0.070	1.03	0.005				Aug. 25, 1906	Reservoir
Central New York	74		2.0	0.058	0.025	0.94	0.003				Oct. 9, 1906	Reservoir
Central New York	75	160	4.5	0.000	0.015	0.88	0.003				June 1907	Reservoir
Reservoir	76	139	1.6	0.006	0.018	0.85	0.002		192	Negative	Dec. 1907	(Hazen & Whipple)
Faucet	77	145	1.62	0.008	0.020	0.50	trace		4	Negative	Feb. 1908	State Board of Health Report
Faucet	78	147	1.75	0.020	0.012	0.80	trace		60	Negative	Sept. 1908	State Board of Health Report
Filtered	79	494	46	0.026	0.005	0.10	0.000	0.92	475		Nov. 1908	Mohawk River west of Fonda
Fulton	80	130	6.2	0.000	0.000	1.04	0.000	0.25			May 1910	City supply upper spring
Fulton	81	172	9.8	0.000	0.002	1.00	0.000				May 1910	Second spring
Fulton	82	1108	441	0.006	0.044	0.16	0.000	1.12			May 1910	Great Bear spring
Fulton	83	442	144	0.020	0.016	0.40	0.000				May 1910	Pump House
Paris, N. Y.	84	230	0.00	0.005	0.050	0.72	0.000	0.50			July 1907	County Springs (Booth)
Paris, N. Y.	85	229	2.28	0.018	0.052	0.40	0.000	1.12		Present	Nov. 1910	Lederle Laboratories
Oneida County	86	264		0.66	0.030	1.40	0.0009	0.75				Supply for canning factory workmen
Onondaga County	87	112	2.1	0.010	0.040	0.50	0.000	0.45			Sept. 1908	Far from buildings
Northern New York	88	80	5.7	0.072	0.025	1.56	0.002	0.83	1020	Absent	July 1907	County spring
Tompkins Co.	89	333	11	0.00	0.05	0.00	0.000				Nov. 1903	County spring used for bottled water
Intake	90	140	0.00	0.000	0.020	0.20	0.000	0.90	900	Present	Nov. 1912	New town supply Mohawk Valley
Town	91	140	0.00	0.012	0.016	0.20	0.000	0.92	450	Present	Nov. 1912	New town supply Mohawk Valley
Lyons	92	2170	45	2.20	0.27	0.00	0.001		2000	Absent		New wells about 60 ft deep
Lyons	93	4880	700	0.38	0.05	0.00	0.000		400	Absent		All abandoned
Lyons	94	3006	45	5.64	0.05	0.00	0.000		500	Absent		
Lyons	95	3780	260	2.14	0.10	0.10	0.000					
Adirondacks	96	20	40	0.02	0.24	0.40	0.000	1.61	10000	Absent	July 1908	Several deaths from typhoid at a private club
Adirondacks	97	60	40	0.04	0.17	4.00	0.003	0.73	210	Absent	July 1908	
Adirondacks	98		0.00	0.025	0.175	1.60	0.000	2.00	26250		July 1908	
Adirondacks	99		0.00	0.066	0.40	0.23	0.000				Nov. 1908	New wells on high ground. No further trouble
Adirondacks	100	84	1.0	0.05	0.15	2.6	0.003	2.15	14	Absent		
Private	101	397	12	0.60	0.10	18.0	0.001		9300	Present	Nov. 1909	Well 18 ft. from stable 20 ft. deep
Private	102								430	Absent	Nov. 1912	Barn made garage. 1910 new
Manufacturing	103	724	100	0.20	0.05	1.45	0.030	5.70	315	Present	Sept. 1908	530 ft. well through rock

Plant	104	564	89	0.37	0.02	0.20	0.800	1.12	......	......	Nov. 1908	Contains hydrogen
Plant	105	504	76	0.16	0.02	0.40	0.050	0.90	8	Absent	Dec. 1908	Sulphide and is not used 60 ft. deep
Private	106	2480	40.5	0.14	0.026	1.22	2.72	1.62	......	......	Oct. 1906	Condemned
Private	107	1332	14.0	0.08	0.025	10.00	0.005	......	......	......	May 1906	Condemned
Utica	108	4520	307	0.82	0.02	0.00	0.000	......	......	......	......	1200 ft. deep, discarded
Texas	109	3794	1770	0.000	0.050	0.00	0.020	2.3	......	......	......	Well in Texas desert
Oswego, N. Y.	110	......	......	0.66	0.24	0.00	0.000	......	......	......	......	Used as a mineral water
Albany, N. Y.	111	700	26	0.00	0.00	0.000	0.000	......	......	......	......	An unusual water
Syracuse	112	1680	27	0.10	0.02	9.62	0.28	1.95	......	......	......	Well 60 ft. deep abandoned
Private	113	166	2.3	0.001	0.009	......	0.000	Before pollution			July 1902	Wells polluted
Private	114	......	88.0	0.50	0.05	......	......	After pollution			Oct. 1902	by cheese factory
Private	115	......	88.0	0.50	0.06	......	......	After pollution				Waste
"Utica"	116	6000	3270	(0.31)		0.00	0.000	55.0	......	......	......	New "mineral water" well
Syracuse	117	3388	11	0.010	0.010	0.00	0.010	1.12	......	......	July 1909	Two 200 ft. wells discarded
Manlius	118	11580	4570	......	......	......	......	......	......	......		220 ft. well discarded
McGraw	119	110	2.0	0.006	0.32	1.24	0.000	......	......	......	Aug. 1908	120 ft. well, new
McGraw	120	100	.10	0.02	0.025	1.00	0.000	......	......	......	June 1909	120 ft. well, second analysis
Oneida Lake	121	144	0.00	0.02	0.06	0.00	0.00	......	......	......	......	Taken in Feb. 1904 through ice
Otisco Lake	122	109	3.0	0.04	0.03	0.07	0.002	......	......	......	Feb. 1910	
Contrexville (mineral water)	123	2670	10	0.02	0.025	0.025	0.025	......	......	......	Oct. 1908	Bottled in France
New Syracuse	124	268	1.5	0.005	0.020	1.60	0.0005	......	......	......	Nov. 1912	
New Syracuse	125	229	2.6	0.020	0.040	0.20	0.0005	......	......	......	Nov. 1912	Country springs south of Syracuse
New Syracuse	126	142	1.6	0.000	0.020	1.06	trace	0.22	Pumping 10 min. (5)		Nov. 1912	
10 ft.	127	......	10.8	0.00	0.02	1.20	0.000	0.22	Pumping 12 min. (5)	Absent	Oct. 1907	Well driven in shale
20 ft.	128	......	10.2	0.01	0.005	1.28	0.000	0.22	15 min. pumping (1)	Absent	Oct. 1907	Well driven in shale
40 ft.	129	......	9.0	0.00	0.005	1.12	0.000	0.10	20 min. pumping (4)	Absent	Oct. 1907	Well driven in shale
......	130	......	......	......	......	......	......	......	......	......	......	......
......	131	......	......	......	......	......	......	......	......	......	......	......
......	132	......	......	......	......	......	......	......	......	......	......	......
......	133	......	......	......	......	......	......	......	......	......	......	......
......	134	......	......	......	......	......	......	......	......	......	......	......
......	135	......	......	......	......	......	......	......	......	......	......	......
......	136	......	......	......	......	......	......	......	......	......	......	......

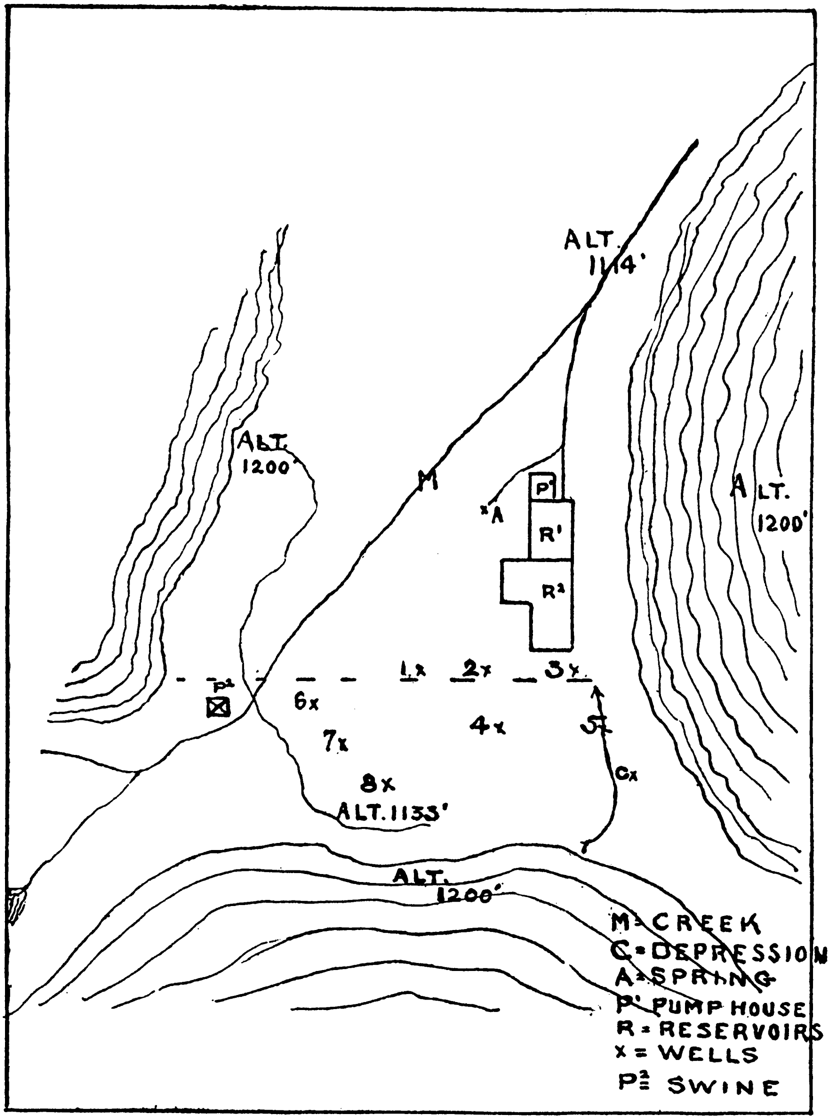
ALT. 1114'
ALT. 1200'
M
A
P¹
R¹
R²
ALT. 1200'
P²
1x
2x
3x
6x
7x
4x
5x
Cx
8x
ALT. 1133'
ALT. 1200'
M= CREEK
C= DEPRESSION
A= SPRING
P¹ PUMP HOUSE
R = RESERVOIRS
x = WELLS
P² SWINE

Fig. 2

DISCUSSION

PROF. J. M. CAIRD: With reference to getting distilled water free from nitrite, is it possible that in a laboratory where a large amount of gas is used this will sometimes prevent getting water free from nitrites?

MR. SHEPPARD T. POWELL: The speaker has found that in the laboratory where we were using gas we got nitrites right along, but after changing over to the use of electric heat, we did not get any nitrites in the distilled water. When you were collecting your distillate, did you seal the tubes with absorbent cotton?

MR. WILLIAM MILLER BOOTH: That was tried, but it did not seem to make any difference in the result so far as nitrites were concerned.